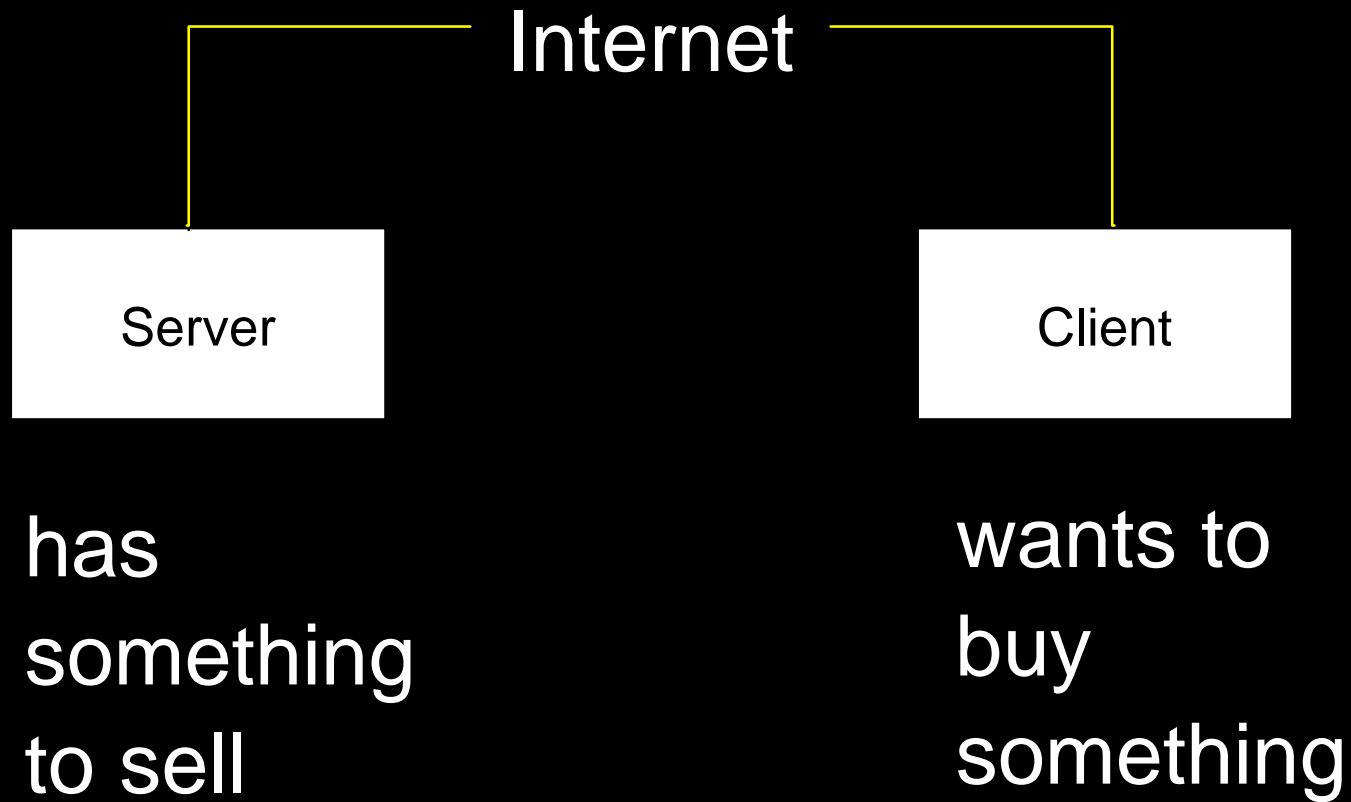
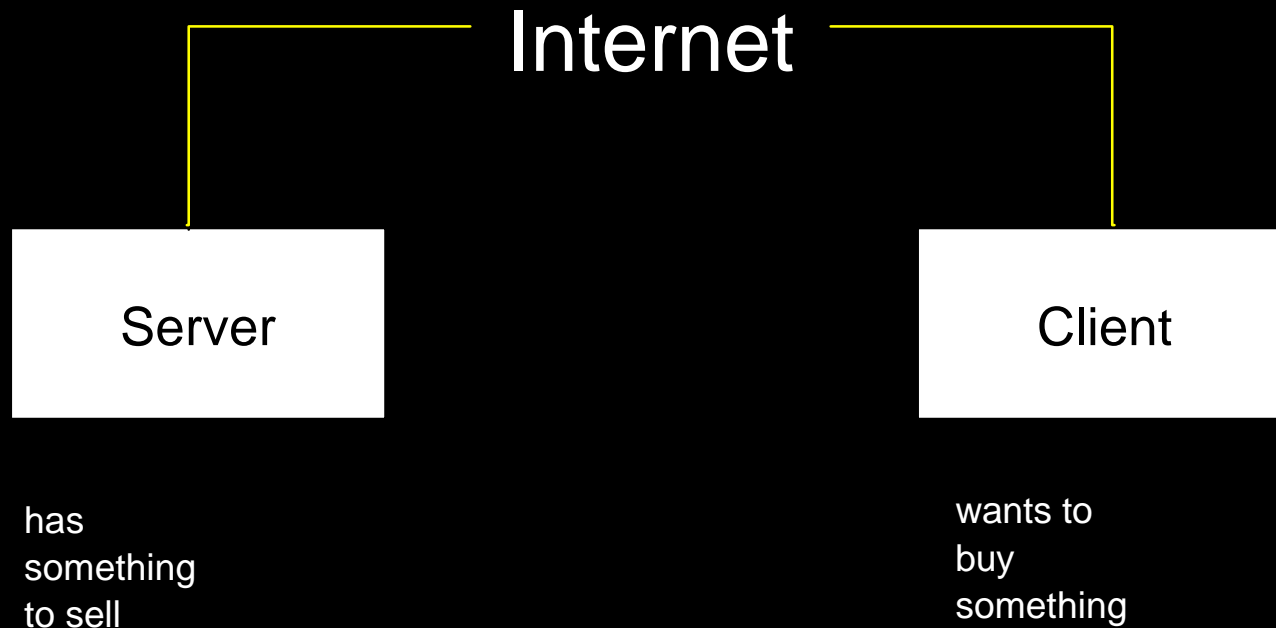


Appearance Issues for E-Commerce

Holly Rushmeier
IBM TJ Watson Research

E-Commerce





'Successes':

- things you don't need to see (books, airline ticket)
- things you have seen (automobiles, groceries)

Internet
Representation?



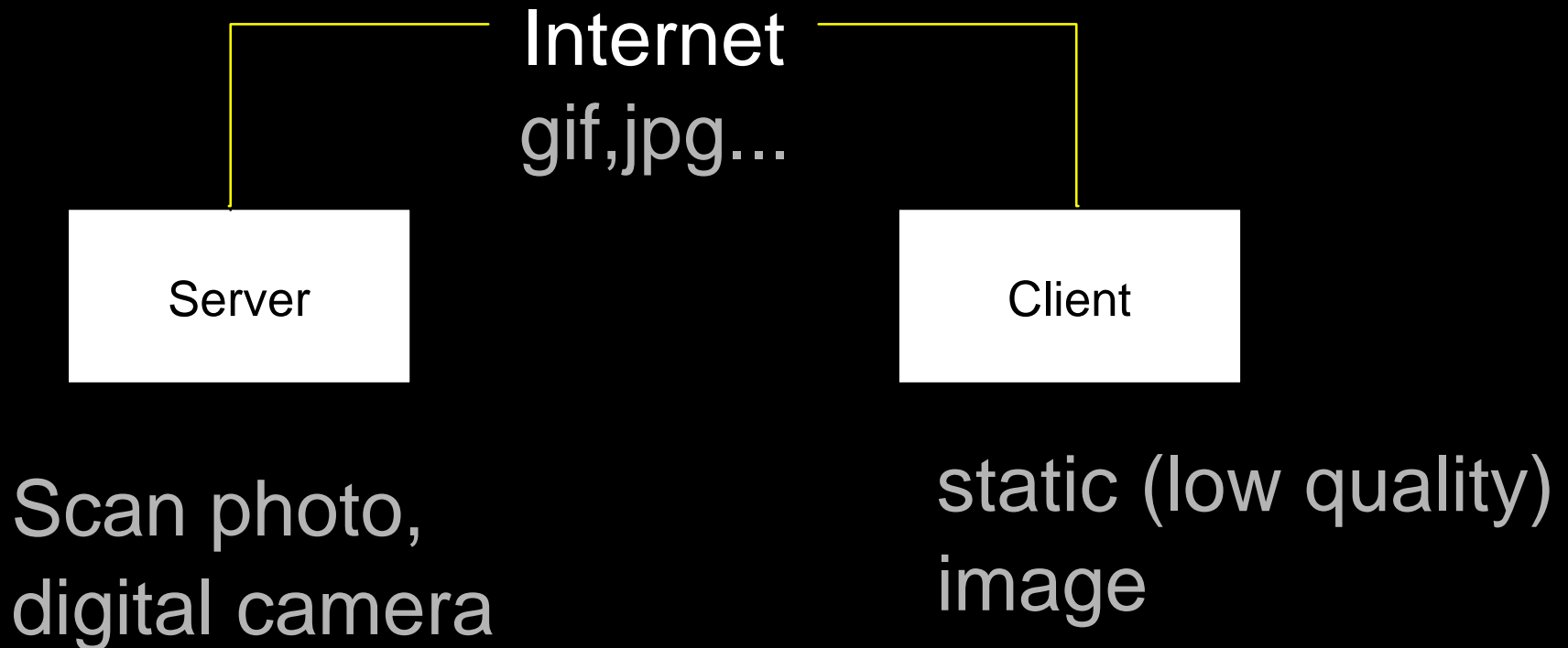
Server

Client

Capture?

View?

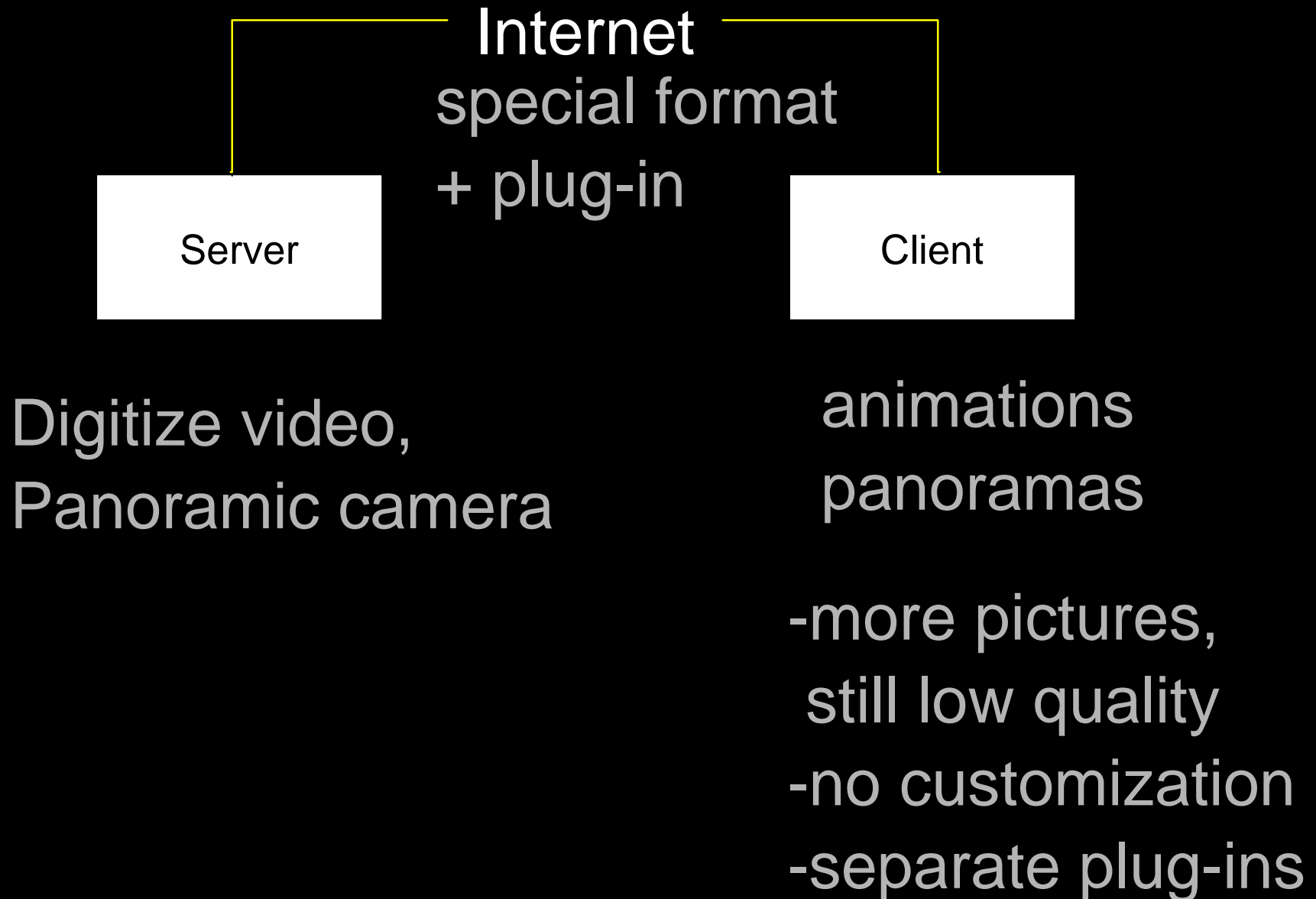
What if appearance matters?



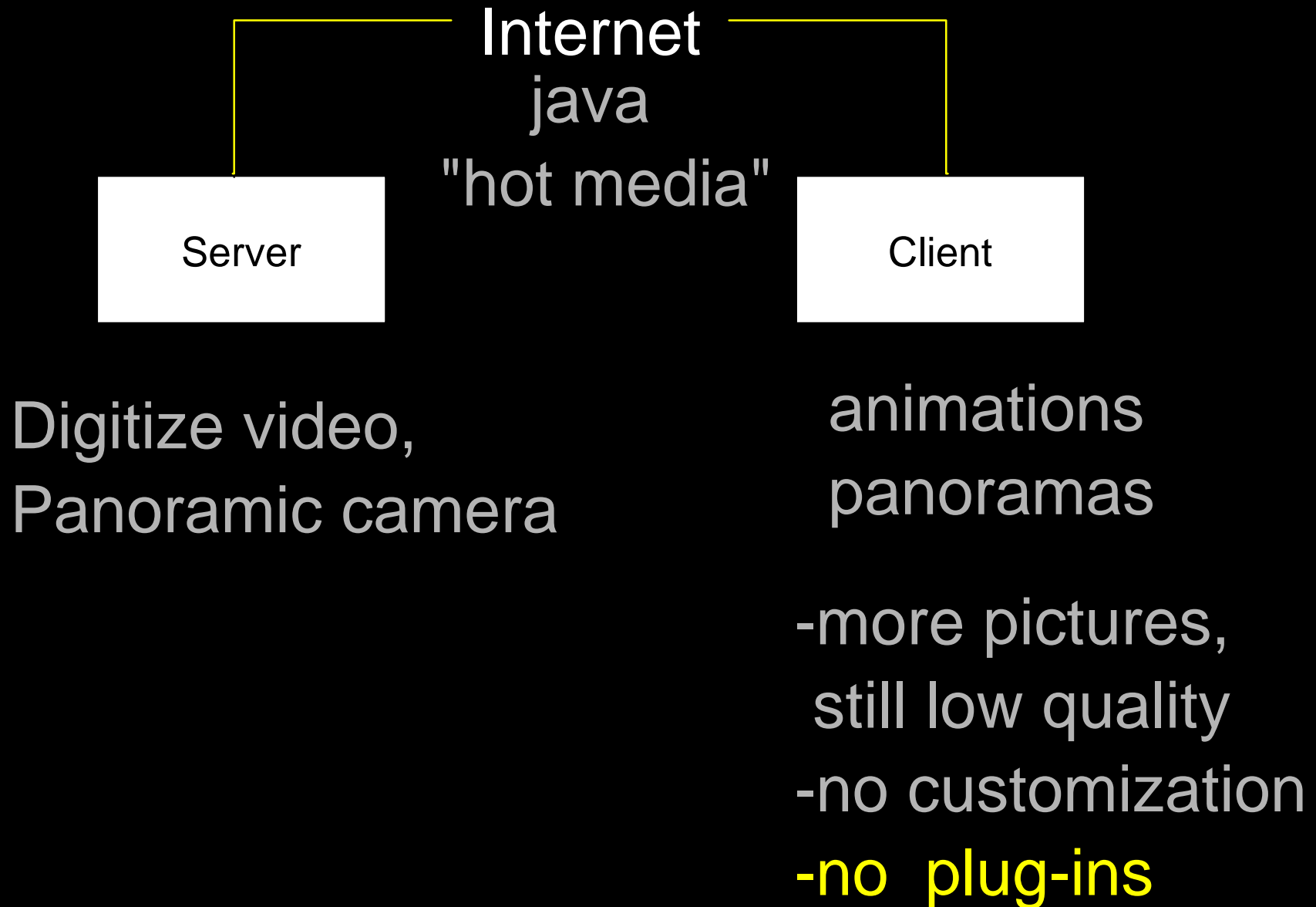
Fast version of traditional catalog.

- instant updates
- faster order placement

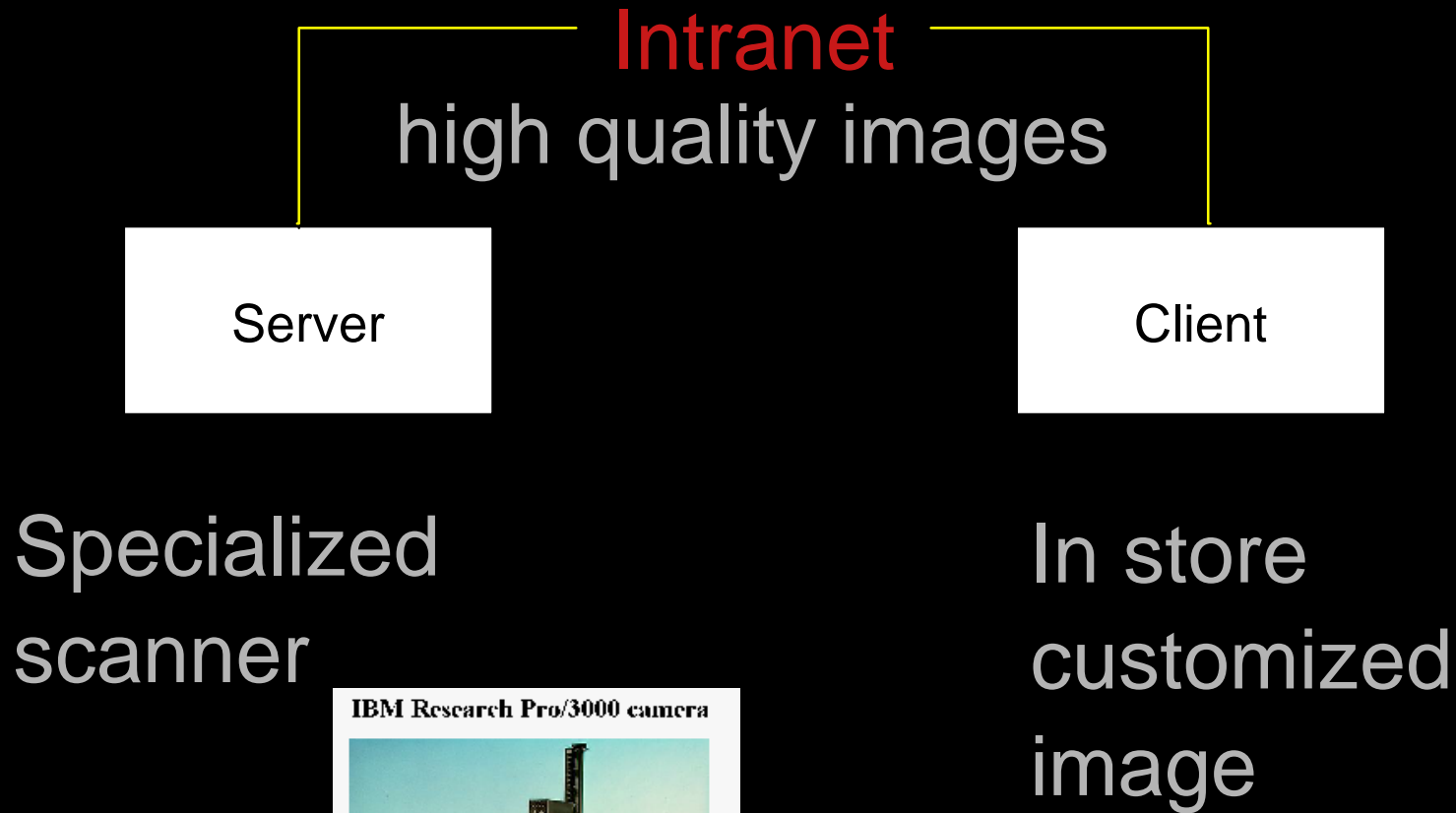
Beyond print catalog presentation?



Plug-ins present barrier:



High Quality + Customization?



Picture in Frame



The process starts with a work of art which is to be framed. If the art work itself is available, it is scanned. If only a color print or chrome is available, then that is scanned.

One or more candidate frames are selected, using the computerized record of the frame inventory. The search criteria may include size of the frame, as well as period, country of origin, and style.

Three candidate frames are shown below.



The results for the three candidate frames are shown below. The client may now study the images on the computer display, or produce high-quality prints of the images, to help in deciding which frame best complements the work of art.

Notice that in these images, the frame images have all been rotated 90 degrees to better fit the painting.



"Picture-in-frame" images

A more general solution?

3D Models on the web, closer simulation of in store experience

The screenshot shows a Netscape browser window with the title bar "E-Commerce Web3D's Killer App - Focus on Web3D - Netscape". The address bar shows the URL "http://web3d.about.com/compute/web3d/library/weekly/aa020200a.htm". The main content area features the About.com logo and a guide by Sandy Bessler. The article title is "E-Commerce Web3D's Killer App" with a dateline of 2/2/00. The text discusses the integration of e-commerce and Web3D. On the right, there are sidebar sections for TechWeb News, Free Downloads, and an Instant Approval offer.

E-Commerce Web3D's Killer App - Focus on Web3D - Netscape

File Edit View Go Communicator Help

Back Forward Reload Home Search Netscape Print Security Stop

Bookmarks Location: <http://web3d.about.com/compute/web3d/library/weekly/aa020200a.htm>

About.com™
The network of sites led by expert guides.

Sat, Mar 25, 2000

Join us
Chat...
Forums...
Newsletters...
& More

Sandy Bessler - your About.com Guide to:
Focus on Web3D

Content: [Welcome](#) | [Netlinks](#) | [Articles](#) | [Guide Bio](#) | [Search](#) | [Related](#)
TalkAbout: [Forums](#) | [Chat](#) | [Events](#) | [Newsletter](#) | [Share This Site](#) | [Join](#)
Shopping: [ShopNow](#) | [Books](#) | [Videos](#) | [Jobs](#) | [ShoppingAbout](#)

E-Commerce Web3D's Killer App

Dateline: 2/2/00

E-commerce has arrived big time, and it's dragging Web3D with it. The ability to go to a Web site and see objects for sale is a compelling Web3D application. OK, it's not necessarily going to make you sit up and get too excited, but we're talking about a useful moneymaking application. I really

In Partnership With
TechWeb

TechWeb News
[Judge Puts Microsoft, DOJ Under The Gun](#)
[RegisterFree Blitized By Free Domain Seekers](#)
[Intel Case Holds Lessons For Microsoft](#)

Free Downloads

Win (all)

Instant Approval
0% APR
APPLY NOW!
VISA

Is 3D for E-commerce really going to happen?



MetaCreations
THE CREATIVE WEB COMPANY

International

Français
Deutsch
US English
UK English
日本語

Products
Our breakthrough products
for web and graphics
professionals

MetaStream
Explore the world of 3D
streaming for the web!

Support
Get support for your
MetaCreations products

Buy
How to buy MetaCreations
products worldwide

Download
Download demos, patches,
and more from
MetaCreations

Company
Corporate info, press
releases, investor relations
and more

CARRARA™
SHAPING THE FUTURE OF 3D



Press and News

2/22/00 MetaStream
International E-Commerce

2/1/00 MetaStream
JCrew.com Custom
[in action!](#)

Customizable E-Business Solutions

Technicon

TechniCon Corp. is a leading provider of electronic commerce solutions for highly variable products. Our advanced Custom Commerce software combines dynamic product selection, configuration and visualization technology to help customers narrow the field of product options and simplify the purchase of complex items. By allowing buyers to select, configure, visualize and order highly variable products directly over the Internet, Custom Commerce dramatically shortens the sales cycle, thus increasing vendor profitability and customer satisfaction.

[contact us](#) | [site map](#) | [opportunities](#)

[ABOUT US](#)

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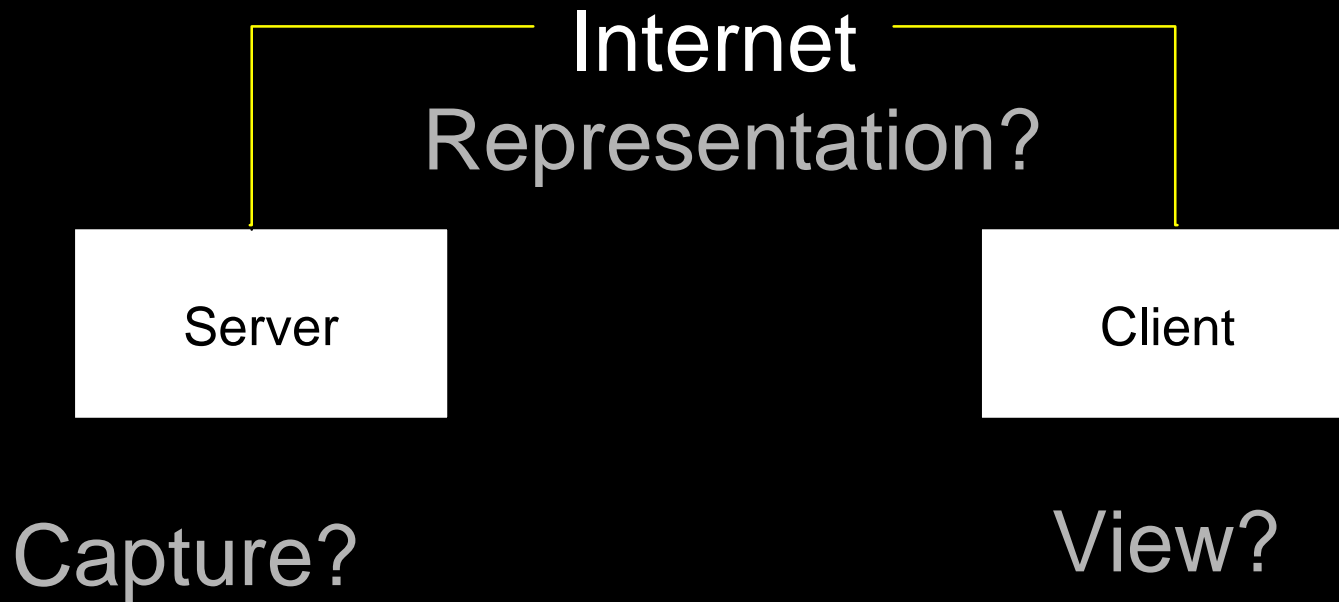
[WHAT'S NEW](#)

Is 3D for E-commerce really going to happen?

Bandwidth increasing
(fiber optic networks)

Graphics card on PC's
(better,cheaper,faster)

Do we just need to wait a couple of years?



Still open problems when
appearance matters for a 3D object.

Today: 3D illustrates functionality

sharperimage.com
You're not signed in!
[sign in](#) [create account](#)

HOME SHOPPING BASKET WHAT'S HOT PRODUCT CATEGORIES WHATS NEW ON SALE

SHOPPING BASKET Search

Love your dog? But not that doggie smell? Now you can brush away pet odors in minutes!

#S1588 - Ionic Bath Pet Brush - \$49.95

Ship To

Why let unpleasant odors get in the way of canine companionship? With our Ionic Bath™ Pet Brush, your pet can maintain that just-back-from-the-groomer freshness with an occasional five-minute brushing. Imagine how much more pleasant smelling your carpets and upholstery will be when the family's favorite member can benefit from a daily "bath" like everyone else!

Inside the handle, patented Zenion Effect™ technology electronically generates a stream of ion-rich air. Odor-neutralizing ozone flows through air ducts in the wide brush plate to leave your pet smelling fresh and

3-D ENABLED! - CLICK HERE TO VIEW -

PLUG-IN INFO

Ionic Bath Pet Brush - Netscape



Interactive Options:

- Click , hold, and move the cursor to rotate the object
- Right Click, hold, and move the cursor up and down to zoom
- Click on the power button to turn it on

Today: 3D illustrates fit

MY MODEL
SHOPPING BAG
USER GUIDE
E-MAIL
LANDSEND.COM
ACCOUNT

Your Personal Model from Lands' End

welcome style advice suggested outfits all outfits all items

Cashmere Hooded Zip

INFO BUY\$ REMOVE

Short Sleeve Stretch Tee

INFO BUY\$ REMOVE

Cotton/Lycra® Capri Pant

INFO BUY\$ REMOVE

ROTATE

REMOVE OUTFIT BUY\$ OUTFIT

ROTATE

REMOVE OUTFIT BUY\$ OUTFIT

Tip: The v-neck and soft fabric of this sweater will minimize the volume at your shoulder level.

MY MODEL
SHOPPING BAG
USER GUIDE
E-MAIL
LANDSEND.COM
ACCOUNT

Your Personal Model from Lands' End

welcome style advice suggested outfits all outfits all items

at work modern chic weekend

Rayon Button Front Shirt

INFO BUY\$ REMOVE

Rayon Shell

INFO BUY\$ REMOVE

Rayon Pant

INFO BUY\$ REMOVE

ROTATE

REMOVE OUTFIT BUY\$ OUTFIT

Stretch Cotton Ballet-neck Dress

Rayon Shirt Jacket
Cotton Stripe Tee, T
Pants

TRY ON

Today: Business to Business

Internet
image

Server

Client

CAD model
Rendering Software

custom
specifications

CAP *About CAP*

CAP Products

CAP Gallery

CAP News

Customer Service

Manufacturers

CAP was founded in 1978, and was acquired by The McGraw-Hill Companies in 1990. CAP's two main product offerings are CAP Studio, and CAP Offices Online.

- **Data** - The industry's most comprehensive collection of furniture catalogs and CAD 2D/3D symbols.
- **On Time** - Electronic catalogs and symbol libraries are updated monthly.
- **Superior Technical Support** via our 800 line - Professional, experienced CAP and AutoCAD specialists will assist you. The best tech support in the business!
- **Training** - Receive CEU's through CAP's *IDA* approved and accredited courses.
- **Stability and Resources** - CAP is a business unit of the McGraw-Hill Construction Information Group.

Gallery

more information about any of these products, please call us at 800.CAP.0038.

CAP News

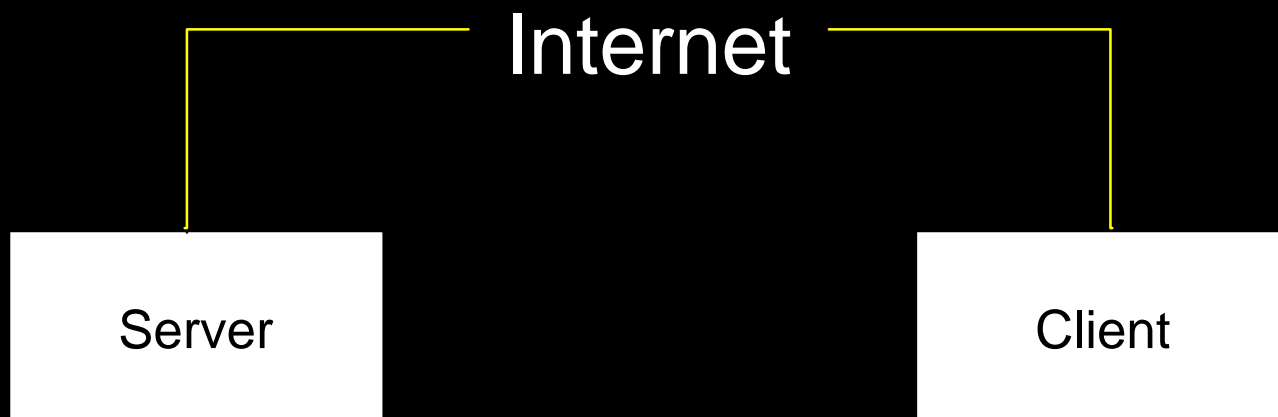
Customer Service

Manufacturers

Where imagination meets technology...

Open problems when appearance matters for a 3D object

3D with what attributes?



Capture?

What if no CAD model?

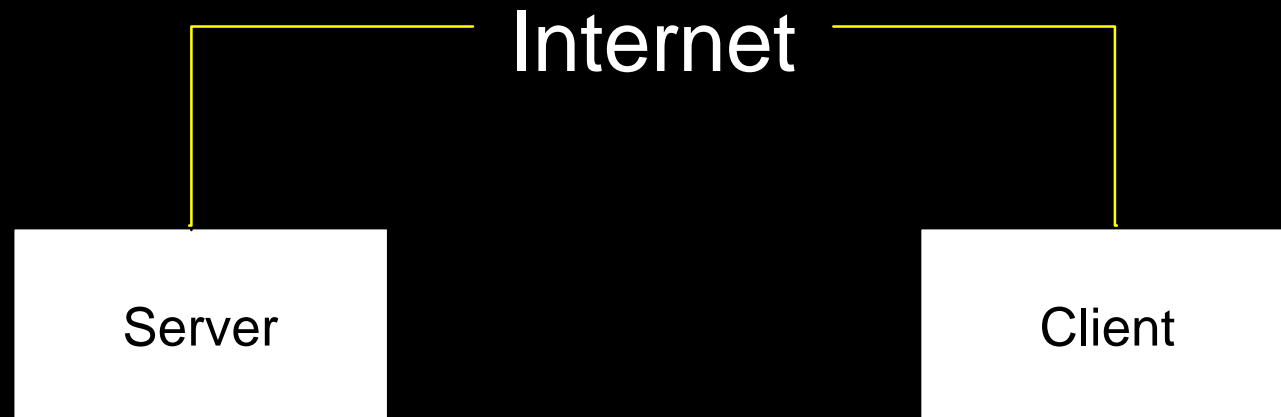
What if real surface
detail is needed?

Intuitive?

Accurate?

standards

3D with what attributes?



Capture?

What if no CAD model?

What if real surface
detail is needed?

scanners

Intuitive?

Accurate?

user interaction
perception

Scanners



Cheap?
Robust?
Easy to Use?
Appearance?



http://www.vit.iit.nrc.ca/Pages_Html/English/Links.html

Scanners

- + Cheap? < \$10,000 exist
- + Robust? don't require lab environment
- Easy to Use? manual intervention
all but small objects
- Appearance? digital images as textures
no fine scale geometry
no reflectance data

Case Study: Scanning Appearance of a Large Object



Why IBM?

Research Challenges:

- High quality required

- Non-technical user

- Budget restrictions

 - Scanning Equipment

 - User PC

Corporate:

- Publicity for company support
of the arts

 - media coverage

 - kiosk program



Design Considerations

Length Scales

Examine on the scale of
meters to study
proportion, design



2.25m

Examine on the scale of
millimeters to study
tool marks



0.15m

Inexpensive scanners

- ▶ Built for limited physical size, desktop scanning

Large scale scanners

- ▶ Expense, accuracy, lead time, availability

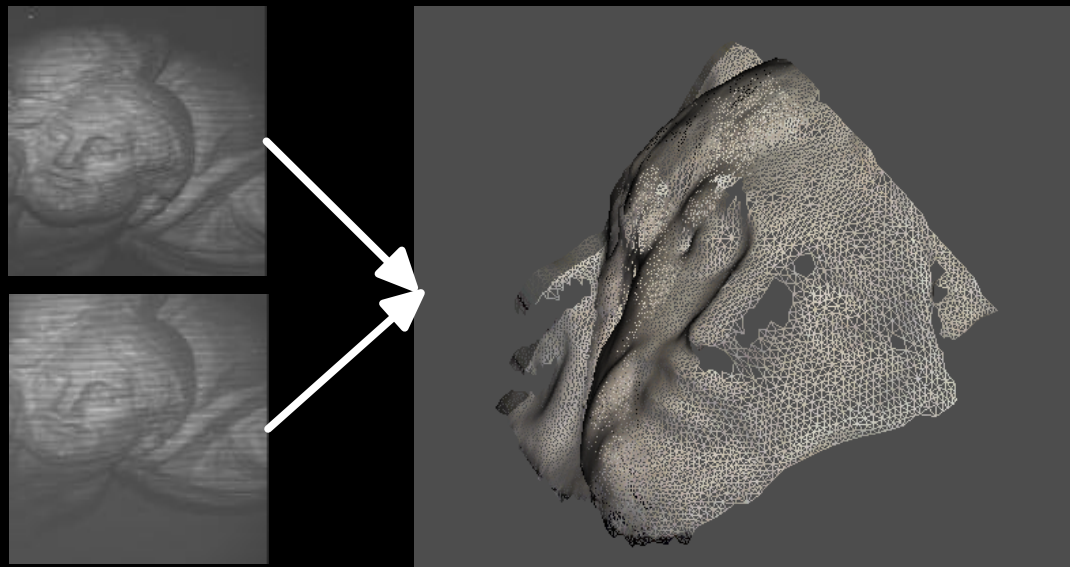
Our Choice: Virtuoso from Visual Interface

- ▶ Availability
- ▶ Cost
- ▶ Size/Weight
- ▶ Company Flexibility

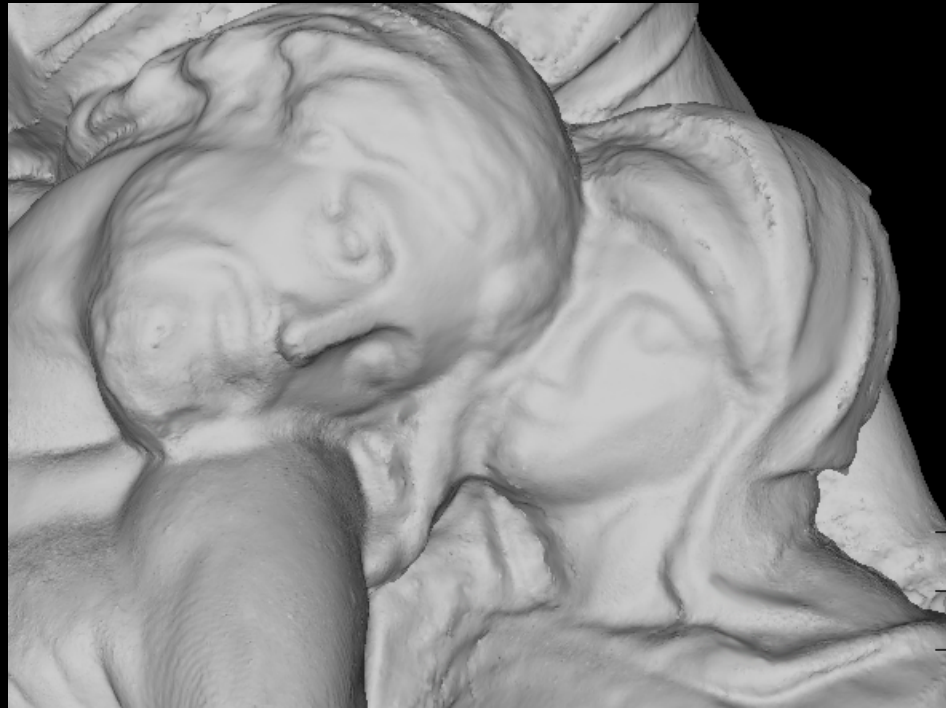


Shape capture

- ▶ Different viewpoints, same lighting pattern
- ▶ Resolution of 2mm, not enough
- ▶ Color images contain lighting effects
- ▶ Scan size is about 20x20cm, need to align hundreds of scans

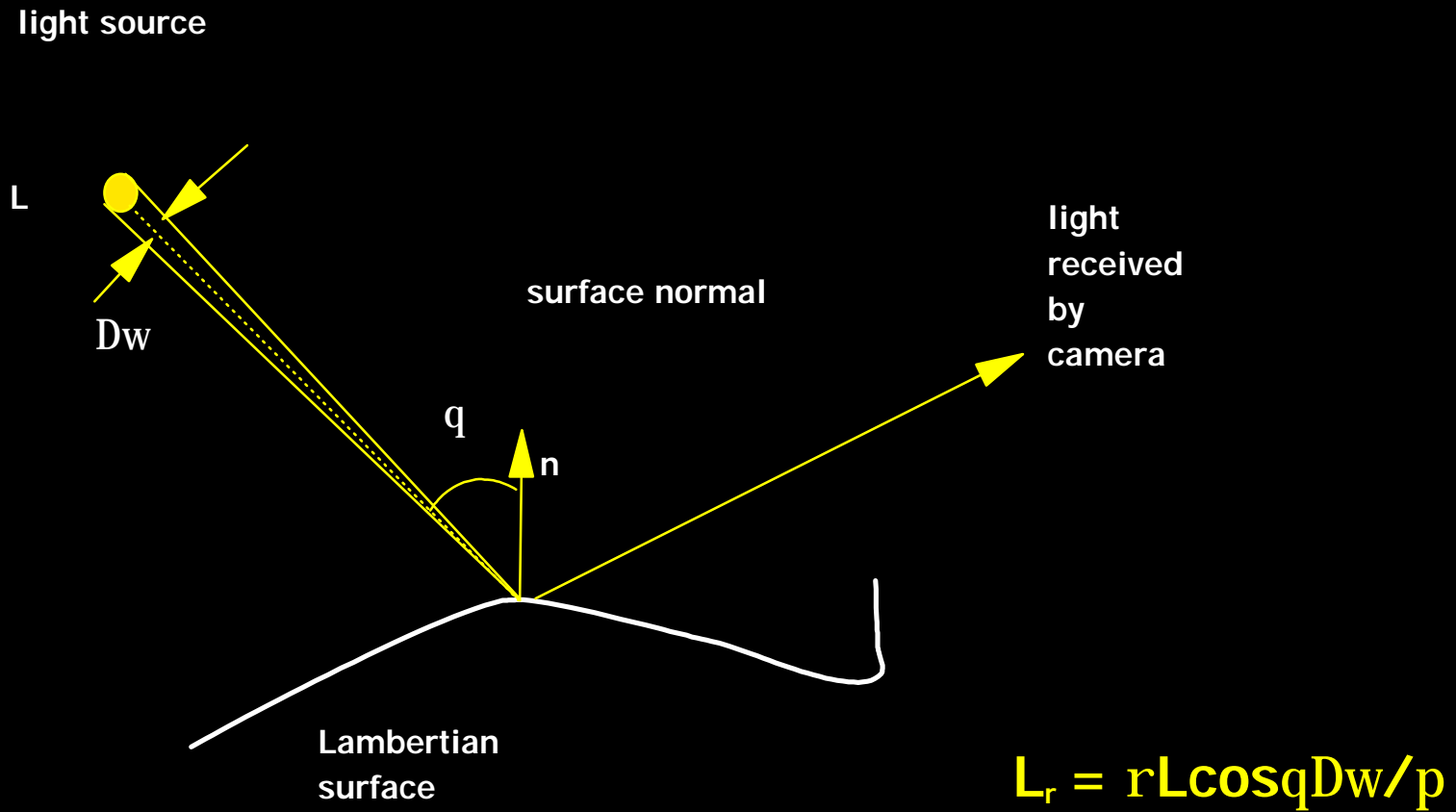


meshed
2mm surface



professional
b&w photograph --
with detail,
shadows,
highlights





Five light sources:

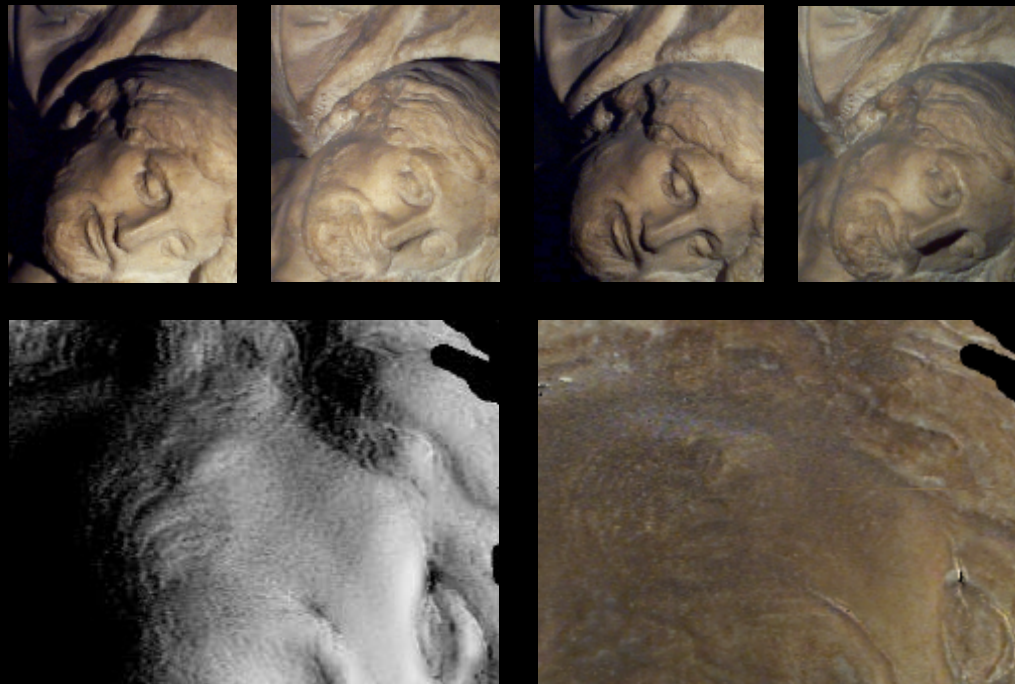
Non - Lambertian surfaces -- don't use highest Lr to avoid specular peaks

Shadows -- no information (may be cast or attached) -- don't use zero values

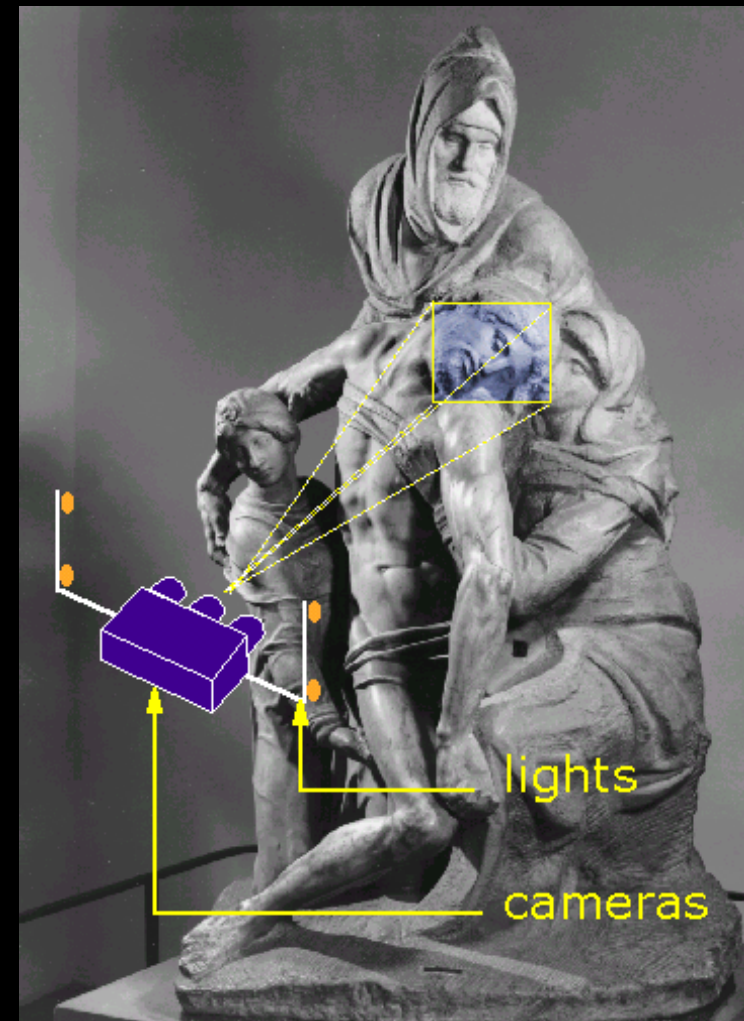
Keep apparatus reasonable size

Photometric capture

- ▶ Same viewpoint, different lighting
- ▶ Resolution of .5mm with Virtuoso built-in camera
- ▶ Compute reflectance and normals per pixel



Final camera design





Potential Problems:

Light sources not identical

Directional variability of individual sources

Temporal variations of sources

Power regulation

Varying distances

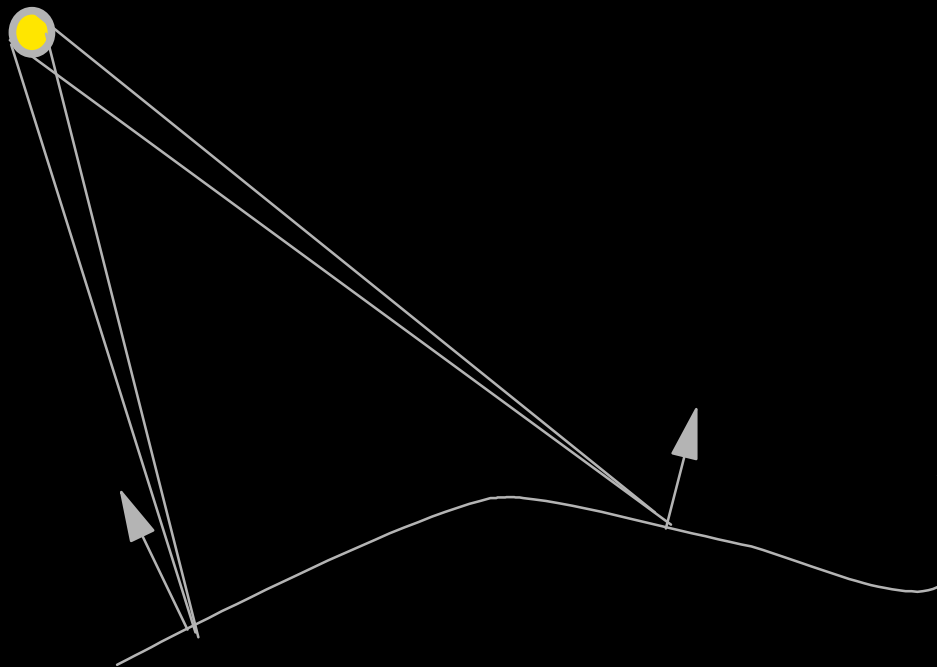
Varying spectra of light sources

Straightforward use of underlying mesh

light
source

$\Delta\omega$ and θ can be
computed

L

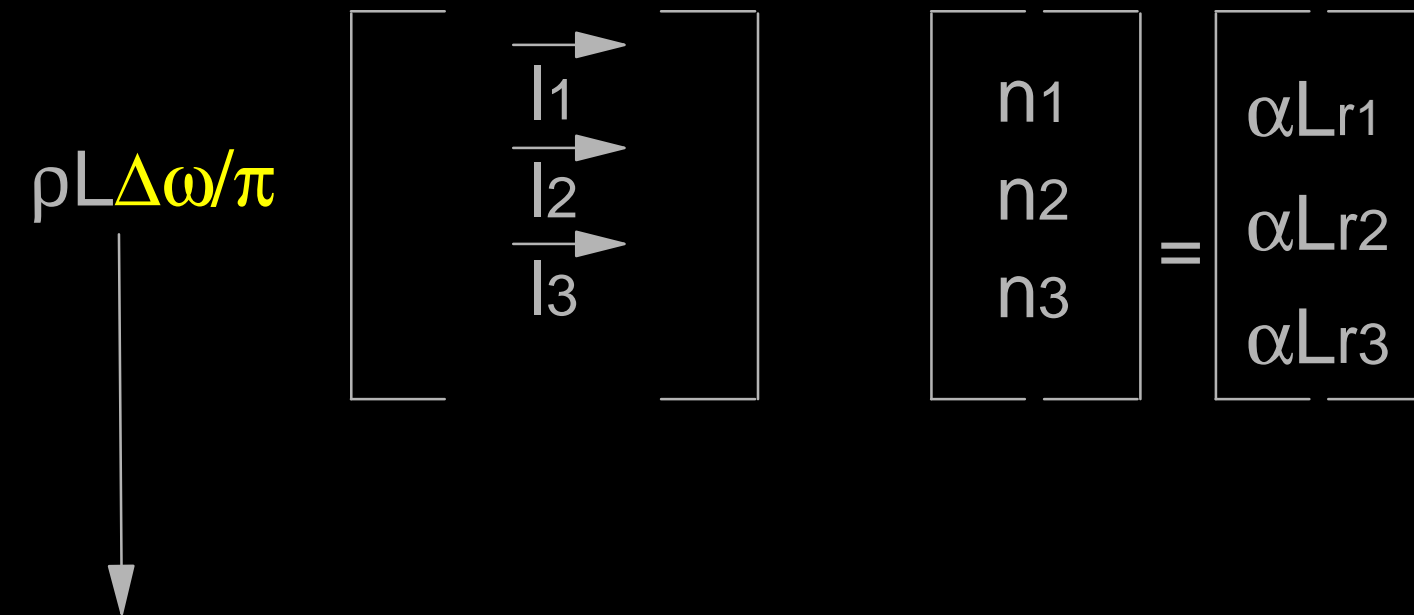


light
received
by
camera

$$\rho L \cos\theta \Delta\omega / \pi$$

$$= Lr$$

Straight Forward Use of Underlying Mesh



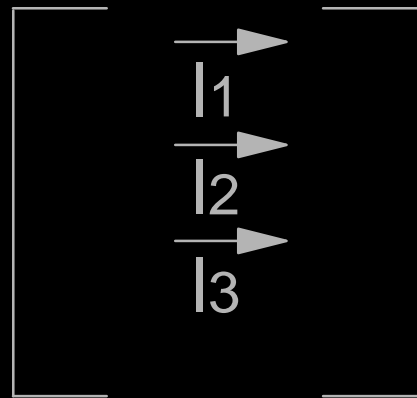
$$\rho L d^2 / r_{p,i}^2$$

account for
varying solid angle

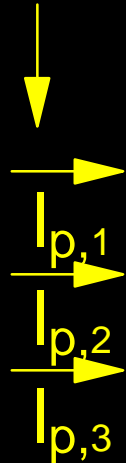
d = light diameter
 r_{pi} = actual distance
to light i

Straight Forward Use of Underlying Mesh

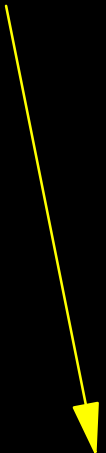
$$\rho L d^2 / \pi$$



$$\begin{bmatrix} n_1 \\ n_2 \\ n_3 \end{bmatrix} = \begin{bmatrix} \alpha r_{p,1}^2 L r_1 \\ \alpha r_{p,2}^2 L r_2 \\ \alpha r_{p,3}^2 L r_3 \end{bmatrix}$$



compute specific direction
to light from point
rather than assume
constant directions

$$\rho L d^2 \begin{bmatrix} \rightarrow \\ I_{p,1} \\ \rightarrow \\ I_{p,2} \\ \rightarrow \\ I_{p,3} \end{bmatrix} = \begin{bmatrix} n_1 \\ n_2 \\ n_3 \end{bmatrix} = \begin{bmatrix} \alpha r_{p,1}^2 L r_1 \\ \alpha r_{p,2}^2 L r_2 \\ \alpha r_{p,3}^2 L r_3 \end{bmatrix}$$


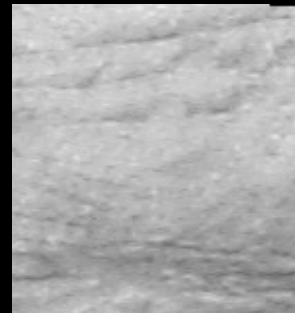
What if L isn't constant for all three sources??
 directional variability, source to source variability

Adjust images so that relative light levels at lower resolution match the relative levels of the underlying mesh illuminated from the same direction.

input image
from
photometric



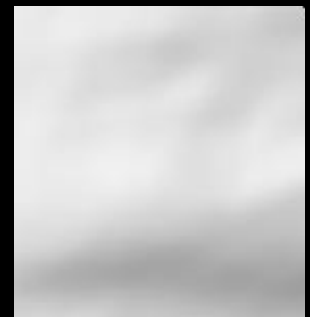
grey

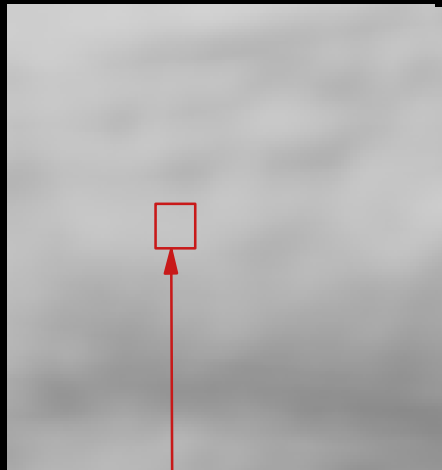


blurred to
2 mm res.

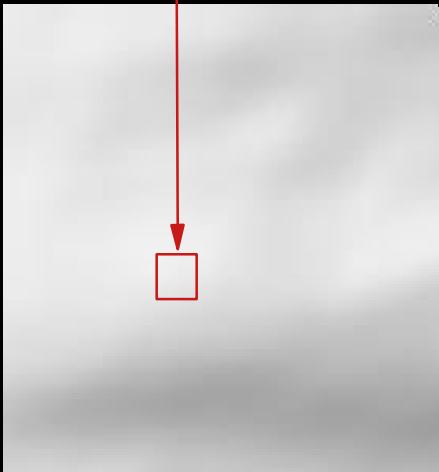


underlying
mesh





average reflected radiance $\alpha \bar{L}_{p,i}$



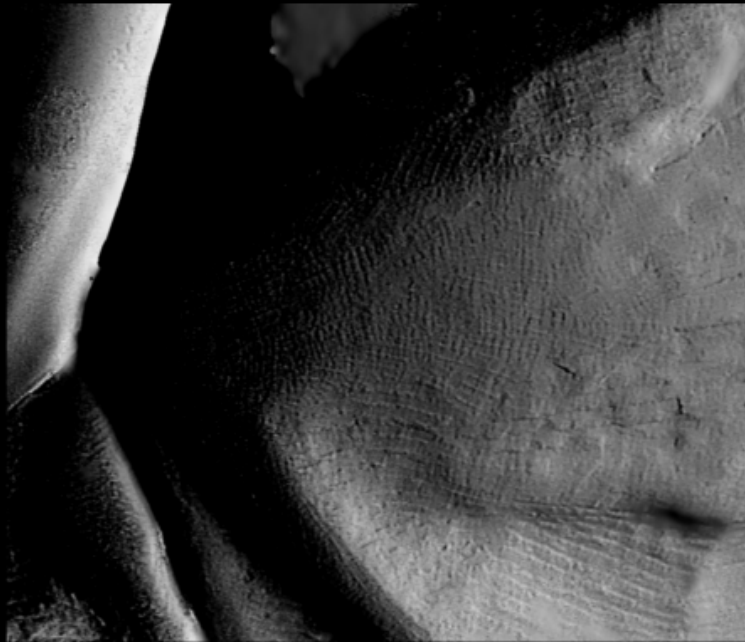
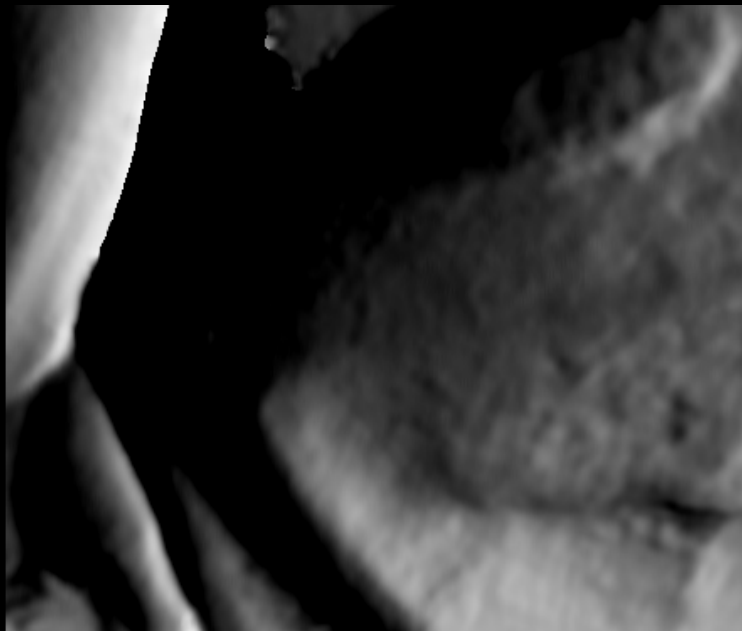
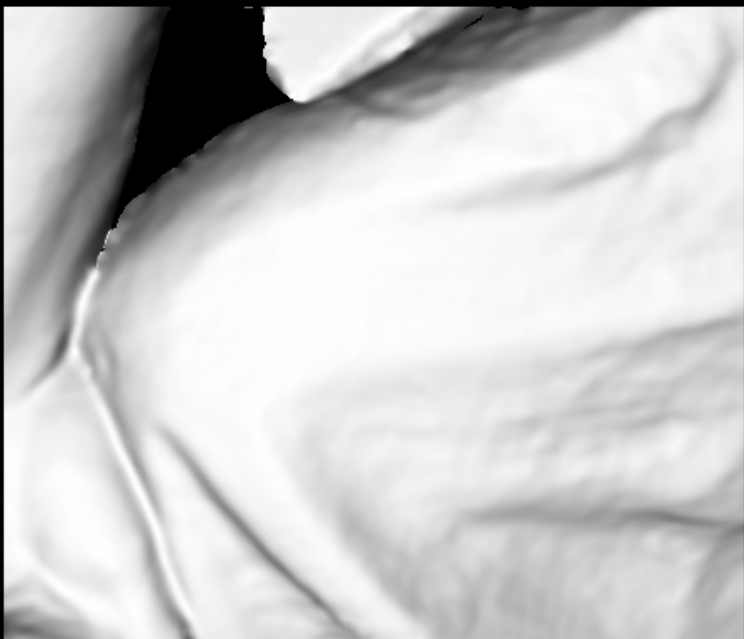
average reflected radiance $\tilde{L}_{p,i}$

does not include α or ρ

$$\rho L d^2 \begin{bmatrix} \rightarrow \\ I_{p,1} \\ \rightarrow \\ I_{p,2} \\ \rightarrow \\ I_{p,3} \end{bmatrix} \begin{bmatrix} n1 \\ n2 \\ n3 \end{bmatrix} = \begin{bmatrix} \alpha r_{p,1}^2 L_{r1} \left(\widetilde{L_{p,1/\alpha}} \overline{L_{p,1}} \right) \\ \alpha r_{p,2}^2 L_{r2} \left(\widetilde{L_{p,1/\alpha}} \overline{L_{p,1}} \right) \\ \alpha r_{p,3}^2 L_{r3} \left(\widetilde{L_{p,1/\alpha}} \overline{L_{p,1}} \right) \end{bmatrix}$$



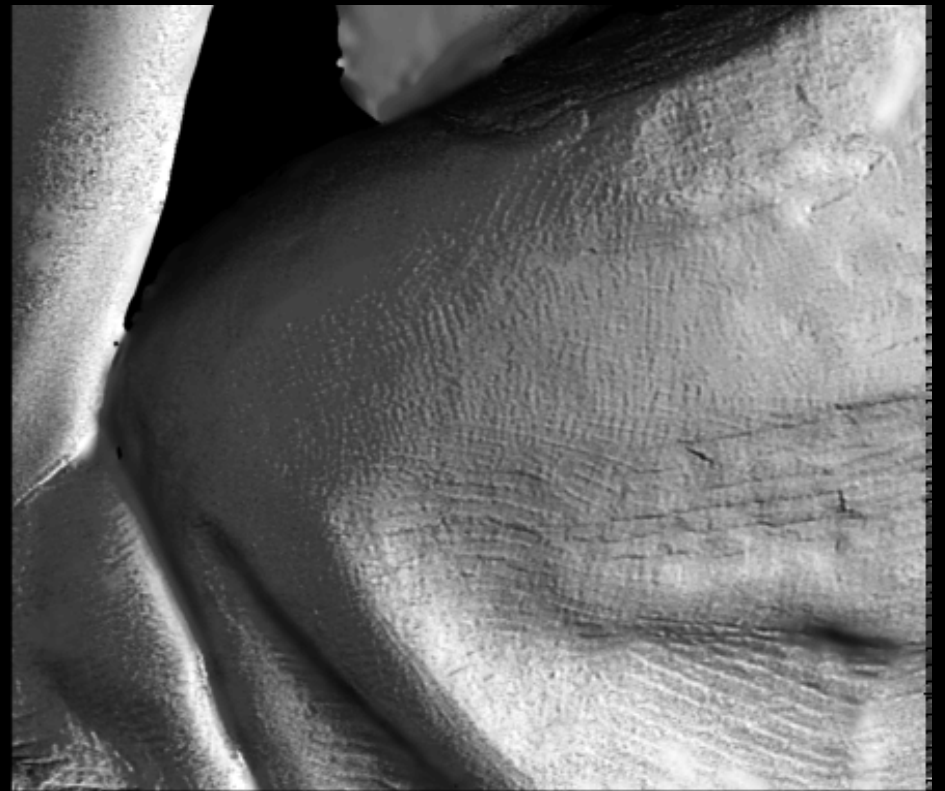
Source correction factor based
on underlying mesh



Is Detail Real?

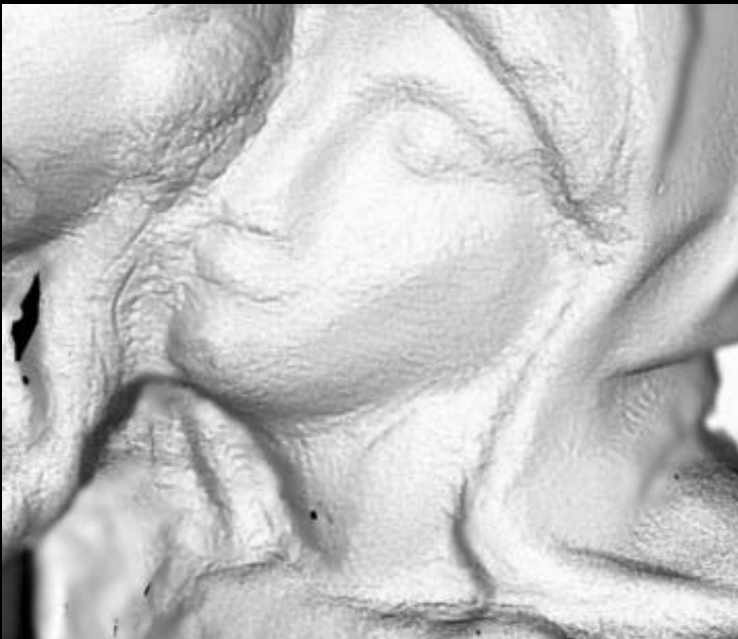


photograph



synthetic from
normals

photograph



normals



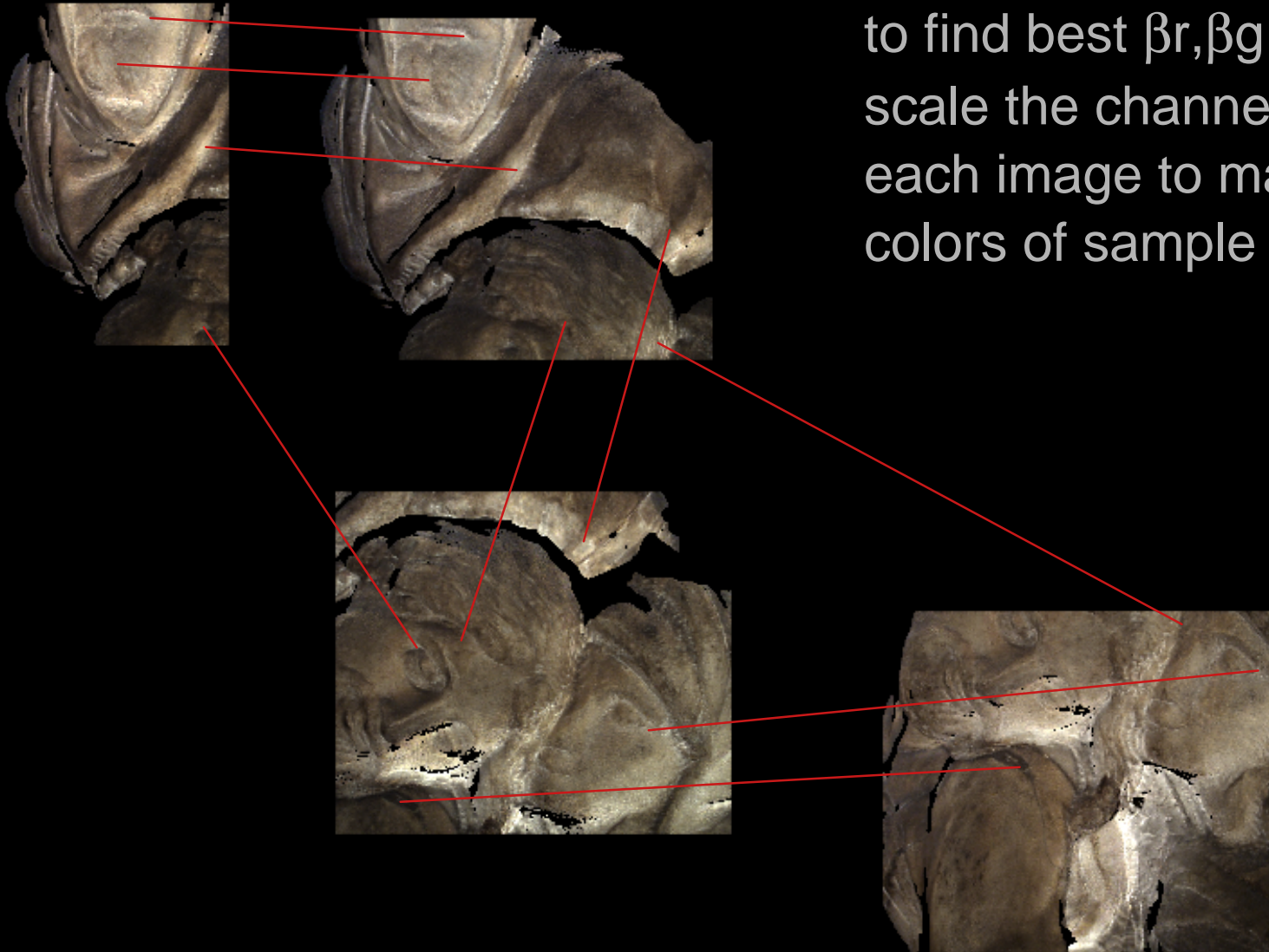
five
color
images

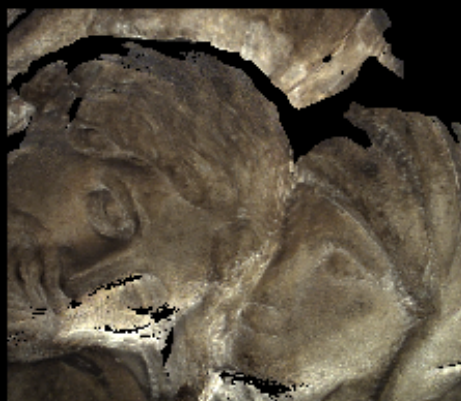
position
and
normals



use geometry and normals
to
"undo" lighting, average
results from five images

Solve least squares
to find best $\beta_r, \beta_g, \beta_b$ to
scale the channels in
each image to make
colors of sample points match



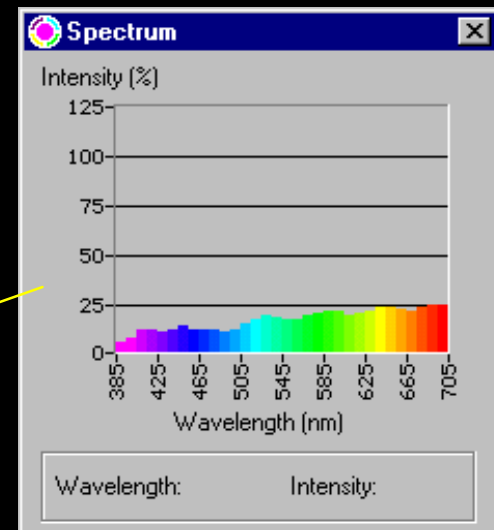


before

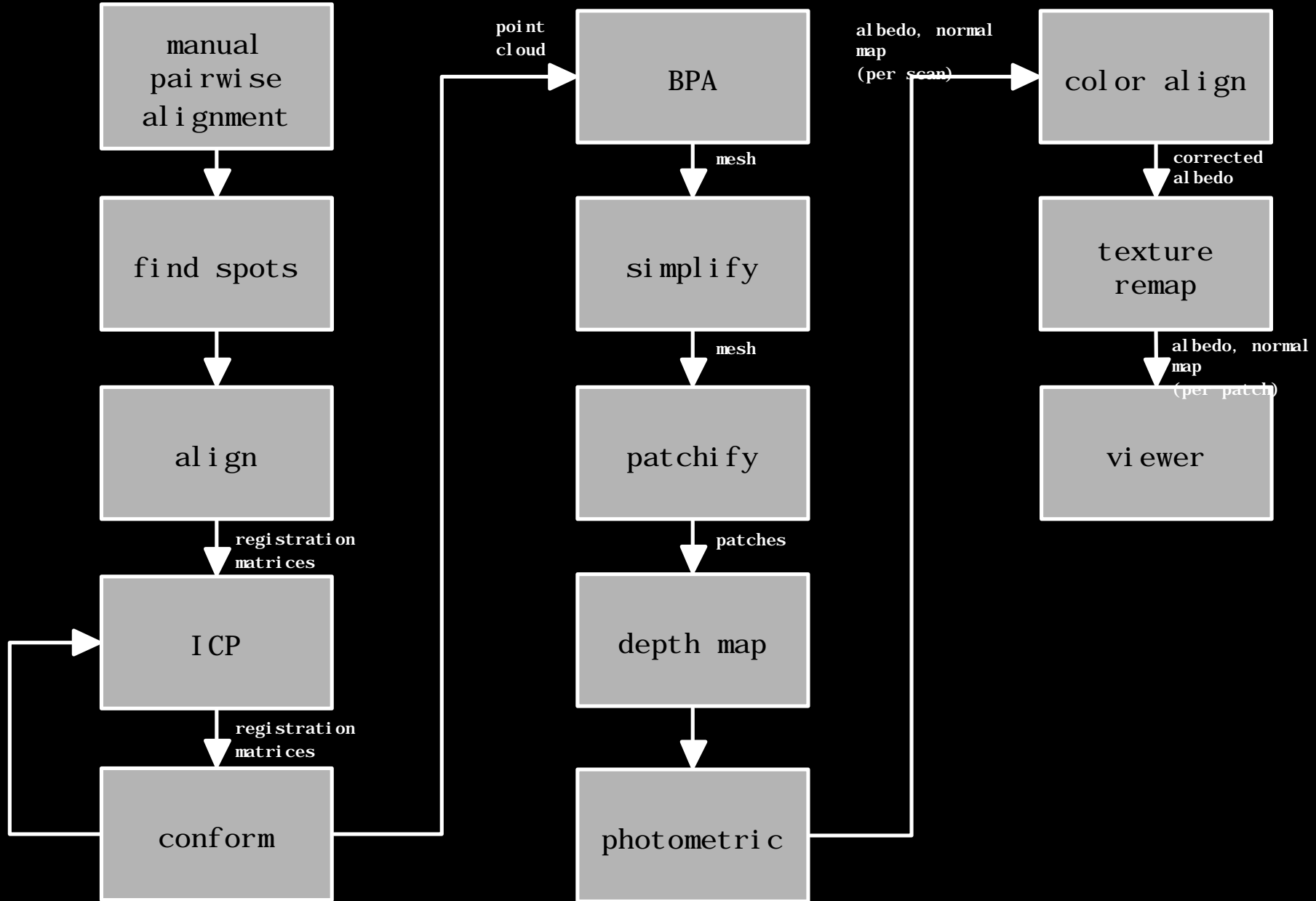
after

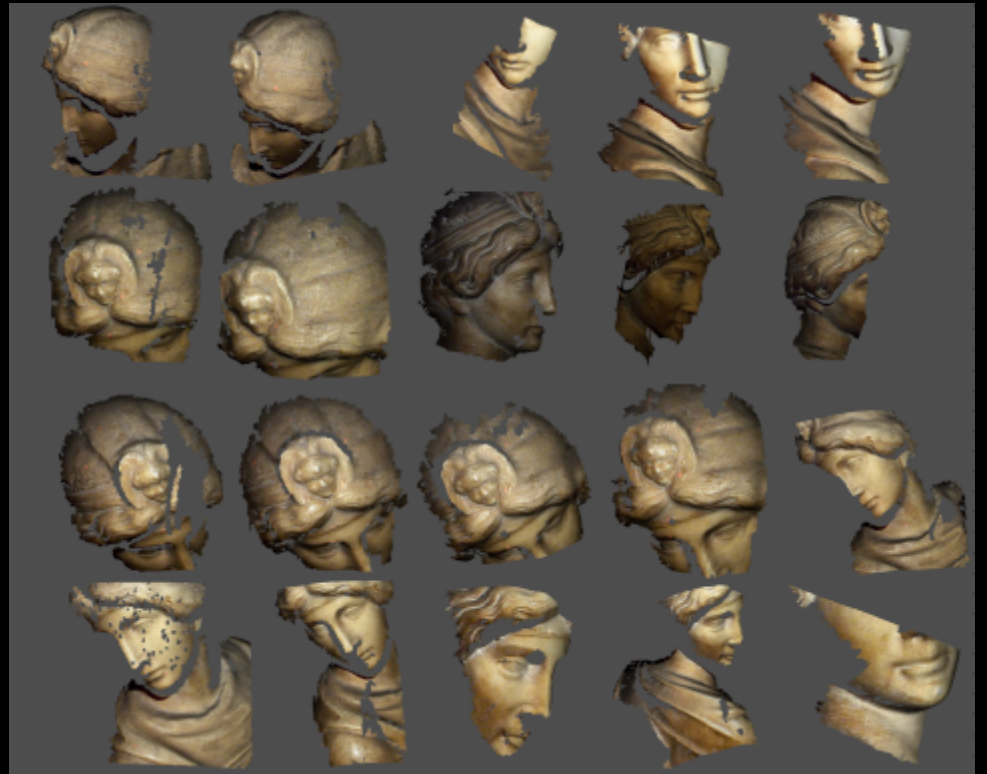
True color?

Set level of images with spot measurements











Other Issues

Representation?

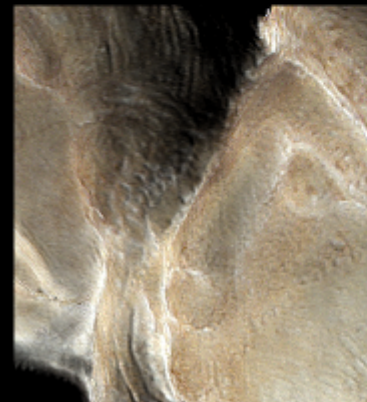
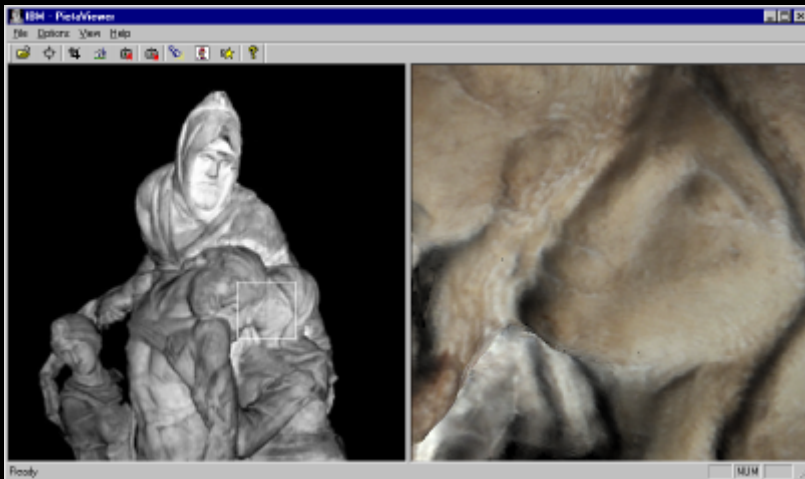
Triangle mesh + normals images + albedo images

Millions of triangles, ~ thousand 24 bit images, and still not a complete description of appearance.

Other Issues

Viewer ?

Small enough for PC, semi-intuitive



Other Issues

Viewer

How much can we rely on maps versus geometry?

Diffuse reflectance not enough, how much more accuracy do we need?

Viewer looks different on every monitor?

Conclusions

There are e-commerce applications where appearance matters

Bandwidth + graphics cards coming
but they aren't enough

- Scanning shape + appearance still hard
- No standards for an object with its appearance
- No intuitive, accurate viewers

